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Model for U.S. Farm Financial Adjustment Analysis of Alternative Public Policies

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Abstract
As the agricultural sector adjusts to financial stress and constantly changing national and international policies, additional structural changes are expected. The capacity for adjustment through existing agricultural asset markets depends on both the extent of farm restructuring and the resiliency of the markets and agricultural institutions. Research is needed to estimate farm financial restructuring needs and the expected duration of the restructuring process. Projecting the magnitude of change needed for financial stability in agriculture would help in assessing the ability of existing markets and institutions to manage restructuring. Policies to alleviate farm financial stress could then be judged for appropriateness and effectiveness.

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A Model for U.S. Farm Financial Adjustment Analysis of Alternative Public Policies

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Introduction

As the agricultural sector adjusts to financial stress and constantly changing national and international policies, additional structural changes are expected. The capacity for adjustment through existing agricultural asset markets depends on both the extent of farm restructuring and the resiliency of the markets and agricultural institutions. Research is needed to estimate farm financial restructuring needs and the expected duration of the restructuring process. Projecting the magnitude of change needed for financial stability in agriculture would help in assessing the ability of existing markets and institutions to manage restructuring. Policies to alleviate farm financial stress could then be judged for appropriateness and effectiveness.

A survey of the literature indicates that empirical research related to farm financial stress has been largely descriptive with some analysis of survivability and policy impacts on typical or representative farms. Analysis of farm operator's responses to state and national surveys are used to determine the incidence and intensity of farm financial stress in the United States (Johnson, Morehart, and Erickson 1987; Jolly et al. 1985; National Economics Division, 1985). Other studies assess the farm's survival ability or financial behavior under varied economic conditions (Barkema and Doye, 1985; Barry, 1986; Baum and Richardson, 1983; Mapp and Walker, 1986a; Musser, White and Smith, 1984; Richardson and Condra, 1984; Thompson and Hanson, 1983; Tweeten et al., 1984). Researchers describe potential liquidity and solvency problems and possible firm-level responses to stress given a specific farm description. Their microeconomic models, as controlled experiments, isolate the impacts of policy or environmental changes on a given farm. They provide a quantitative understanding of likely responses and details that are complementary to information provided by macroeconomic models. However, inferences about sectoral changes are not possible from microeconomic projections based on typical or representative farms.

Few researchers have attempted to provide empirical results reflecting costs of financial stress and stress alleviation policies for the agricultural sector (Food and Agricultural Policy Research Institute, 1986; Boehlje et al., 1985). The aggregate analyses in Boehlje et al. were completed using an econometric model of the agricultural sector. Since no attempt was made to develop the link between microeconomic responses and aggregate effects, no insights into the dynamics of farm financial restructuring are provided.

Our study was undertaken to improve understanding of the structural changes required to achieve financial stability in agriculture. A link between individual farm responses to financial stress and the agricultural sector responses is developed. The financial restructuring needs of United States

commercial farms[1] are investigated using data from a national survey of farms (Farm Journal and FAPRI Staff). A cash flow model uses the survey data to simulate farm operators' need to adapt to economic conditions. This publication describes in detail the analytical techniques employed and the model specification. Proposed programs to alleviate farm financial stress are analyzed using the model and policy results are reported to demonstrate the flexibility of the simulation program.

Our research differs from other studies in several significant ways. First, current financial characteristics of heterogeneous farms are used to determine an individual farm's financial growth or disinvestment over time. Second, a direct link exists between adjustment on farms and projected changes for the agricultural sector since changes in asset and debt holdings at the farm level are aggregated to estimate the sector's response. Because of these two innovations, the estimated impacts of national financial policies on farms should be more realistic.

The estimated restructuring needs and analysis of potential policies provide valuable insights into the potential shift of agricultural resources precipitated by farm financial stress and the potential costs of federal policies to alleviate farm financial stress. Potential changes in the socioeconomic and financial characteristics of the farm population from adaptation to the economic environment are clearer. The research should prove valuable to agricultural policy makers struggling to address financial problems of the agricultural sector.

Financial Condition of Farm Operators

According to Jolly et al. (1985), financial stress occurs when certain economic forces assault and break down the adjustment capability of an individual, a firm, or a specific sector of the economy. These researchers indicate that some of the factors contributing to stress--low returns to assets or the absence of profits--signal resource owners to reallocate resources. Financial stress becomes counter-productive when misallocation of resources, undesirable structural change, and losses of economic and human capital become excessive.

Results of a January 1985 survey of United States farmers serve as a basis for this study and provide insights into the financial condition of farm operators. Data used are the results of a random sample of United States farmers surveyed by Farm Journal (FJ), Iowa State University, and the University of Missouri

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[1]Commercial farms are defined here as farms with gross sales exceeding $40,000. Approximately two-thirds of the farms in the United States are classified as commercial farms using this definition.

(Farm Journal and FAPRI Staff, 1985). A sample of 8,000 operators was drawn from the Farm Journal data base sampled from four regions: East, South, Central, and West (Figure 1). Approximately 20 percent of the surveys were returned. For this project, the data from 731 valid responses from commercial farm operators (those with sales of $40,000 or more per year) were used. Because the sample was drawn equally from the four regions and is not a random U.S. sample, regional FJ output is weighted using USDA numbers of commercial operators, assets, and debts by region to derive a U.S.value.

Balance Sheet Statistics. Table 1 lists balance sheet statistics by region and by debt-to-asset ratio. A column labeled "FCRS" lists balance sheet statistics for commercial farms by region as calculated from the USDA's 1985 Farm Cost and Return survey results (Baum, 1985). Within a region, farms in the FJ data set control more assets and have higher debt levels on average than FCRS farms. Average debt-to-asset ratios by region for the two samples are similar.

Table 1 indicates that farms in the West have significantly higher average asset values per farm. Farms in the South are generally larger than farms in the East or Central regions. Average debt levels are also highest in the West but the Central region's average exceeds those of the South and East. The debt-to-asset ratio average is highest for the Central region at about 34 percent compared to 20 to 25 percent for other regions. The weighted debt-to-asset ratio for the United States from the sample is 27.76 percent.

Operator, Asset, and Debt Distributions. Table 2 shows the distribution of commercial operators and the assets and debts controlled by commercial operators in the FJ sample by region and by debt-to-asset ratio. More than half of the nation's commercial farms, nearly half of the assets held by commercial farm operators, and more than half of the debt held by commercial farm operators is in the Central region. As a result, national statistics are greatly influenced by conditions in the Central region. The sample shows a larger share of the operators, assets, and debts in the Central region fall in the highly leveraged debt-to-asset ratio category (40 to 70) and in the very highly leveraged category (70+). More than 42 percent of the operators in the Central region fall into these two categories and these operators control 72 percent of the debt in this region.

For the United States, 35 percent of commercial operators fall in the highly leveraged categories and control 63 percent of the farm debt held by commercial operators. The debt held by financially stressed operators is backed by 27 percent of the assets held by commercial operators. Almost no debt is held by 30 percent of the U.S. commercial operators and they own 33 percent of the assets held by commercial operators.

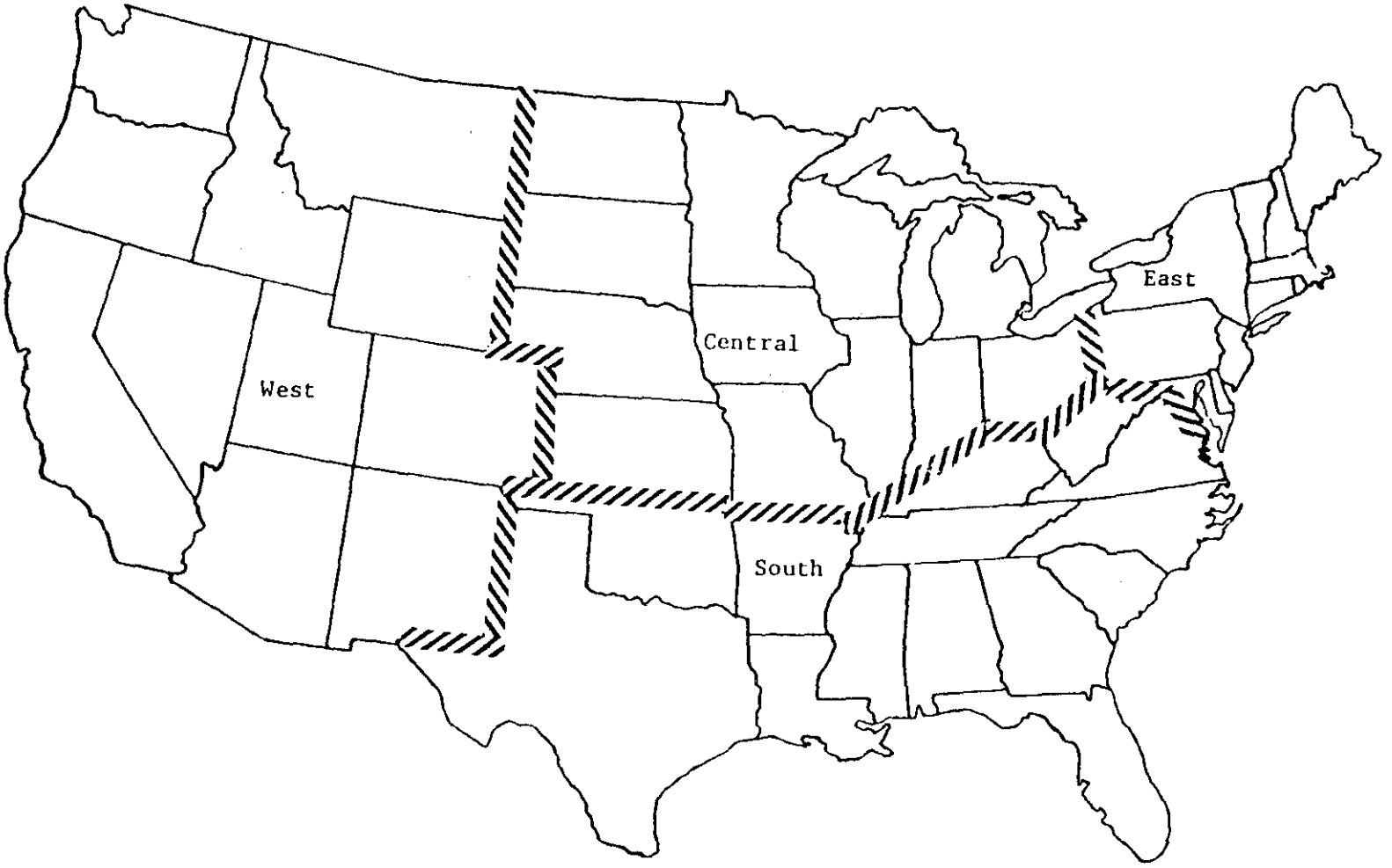

Figure 1. Regions Used in Analysis of Financial Conditions in U.S. Agriculture.

Table 1. Average Financial Position of Commercial Operators in Farm Journal Sample by Debt-to-Asset Ratio (DAR).

Region	Debt-to-Asset Ratio (percent)					
	0-10	10-40	40-70	70+	All	F.C.R.S.[a]
East						
Assets	$598,851	$535,688	$527,690	$373,625	$555,000	$419,049
Debts	$16,696	$135,129	$261,206	$334,484	$111,327	$96,565
Net Worth	$581,882	$400,559	$266,484	$39,141	$443,673	$322,484
DAR (%)	2.83	25.23	49.50	89.52	20.06	23.04
South						
Assets	$870,659	$846,759	$465,673	$216,683	$716,101	$627,844
Debts	$12,045	$205,247	$248,189	$218,583	$152,756	$127,496
Net Worth	$858,614	$641,512	$217,484	($1,900)	$563,345	$500,348
DAR (%)	1.38	24.24	53.30	100.88	21.33	20.31
Central						
Assets	$599,895	$657,841	$616,603	$350,850	$572,991	$496,404
Debts	$11,823	$165,527	$333,188	$341,602	$197,302	$157,207
Net Worth	$588,072	$492,314	$283,415	$8,978	$375,689	$339,197
DAR (%)	1.97	25.16	54.04	97.44	34.43	31.67
West						
Assets	$1,047,738	$1,264,257	$1,144,096	$542,933	$1,098,232	$978,628
Debts	$42,215	$267,189	$626,789	$465,444	$274,987	$246,890
Net Worth	$1,005,523	$997,068	$517,307	$77,489	$823,245	$731,738
DAR (%)	4.03	21.13	54.78	85.73	25.04	25.23
U.S.						
Assets	$763,815	$827,129	$684,080	$358,247	$719,540	$581,844
Debts	$18,147	$191,821	$371,261	$341,959	$199,726	$156,446
Net Worth	$745,688	$635,308	$312,819	$16,288	$519,814	$425,398
DAR (%)	2.38	23.19	54.27	95.45	27.76	26.89

[a]Baum, 1985.

Table 2. Distribution of Commercial Operators, Assets, and Debts in Farm Journal Sample.

Region	Debt-to-Asset Ratio (percent) 0-10	10-40	40-70	70+	U.S.[a]
East					
Operators	45.57	33.54	15.82	5.06	8.19
Assets	49.17	32.38	15.04	3.40	5.90
Debts	6.95	40.72	37.12	15.21	5.05
South					
Operator	32.20	38.14	19.49	10.17	23.76
Assets	39.15	45.09	12.68	3.08	25.63
Debts	2.54	51.24	31.67	14.55	19.36
Central					
Operator	26.85	30.56	23.15	19.44	55.50
Assets	28.11	35.08	24.91	11.90	47.35
Debts	1.61	25.63	39.09	33.67	55.78
West					
Operator	33.47	38.91	17.57	10.04	12.56
Assets	31.93	44.79	18.31	4.96	21.12
Debts	5.14	37.81	40.06	17.00	19.81
United States					
Operator	30.49	33.66	20.98	14.88	100.00
Assets	32.99	39.54	19.80	7.67	100.00
Debts	2.76	33.76	37.75	25.73	100.00
F.C.R.S.[b]					
Operator	34.55	34.44	19.08	11.92	100.00
Assets	38.56	36.26	17.33	7.86	100.00
Debts	3.27	32.78	34.18	29.79	100.00

[a]Baum, 1985.
[b]Economic Research Service, 1985c.

Consequences of Farm Financial Stress

A changed microeconomic financial structure for many farms contributes to liquidity problems and makes them more vulnerable to risk from income variability, collateral and equity erosion, interest rate volatility, and changes in lenders' policies. A crop failure, lower market prices, higher interest rates, or a reduction in a line of credit can dramatically affect the viability of a struggling farm. Given the number of highly leveraged farms, it seems likely that many will be forced to partially or completely liquidate assets to meet debt obligations.

The capability of existing agricultural input markets to handle financial restructuring depends on the extent of restructuring and the resiliency of the institutions involved. Financial asset markets perform much of the restructuring. The Federal Reserve system believes that potential losses and bank failures are not a threat to the banking system nationally (Comptroller General of the United States, 1985). Likewise, Farm Credit Administration officials, the federal regulators of the Farm Credit System, maintain that the FCS, although experiencing huge losses and facing a tough battle in restoring borrowers' confidence is not close to failing (Webster, 1986). And, since the FmHA is a government agency, its existence is not threatened by its troubled portfolio.

Less is known about the financial strength of other lenders who hold one-third of agricultural debt--life insurance companies, agricultural merchants and dealers, and individuals. Agricultural debt (primarily real estate debt) is generally a small portion of the life insurance company portfolio, so life insurance companies are generally not vulnerable to agricultural financial stress. Individuals and local merchants who have extended credit to farmers, however, may suffer immensely when farm loans deteriorate. The retired farmer or farm widow who expects to receive a steady income from the sale of assets may find themselves with a returned farm rather than a pension fund.

Evidence of the impacts of agricultural financial stress on farm real estate markets appeared in the results of the annual Farmland Markets Survey (Economic Research Service, 1985a). In 1985 farmland sold by farmers increased by an estimated 22 percent from 1984. Acres sold by operators as a percentage of total acres of farmland purchased by operators jumped from 72 percent in 1983 to 91 percent in 1984 (National Economics Division, 1985a).

Farmland sales seem to have stagnated and asset prices have fallen dramatically. Although the acreage listed for sale increased, respondents to the Farmland Markets Survey indicated a decrease in the number of actual sales. The number of sales reported for 1985 was the lowest since 1981. For land expected to remain in agriculture, prices per acre sold averaged 24 percent lower in 1985 than in 1984. If the real estate market becomes saturated, the financial

stress of farm operators trying to restructure the farm by selling assets may be exacerbated.

The long-run implications of changes in the number and size of farms for agriculture-dependent businesses and rural communities needs to be addressed. When changes in production agriculture are large, changes can be expected in agriculture-related industries and in rural communities. If, in addition to farms failing, local businesses begin to fail, the economic and social costs of farm financial stress are compounded. Business failures result in economic and human costs that affect the people directly involved and other firms whose operations depend on the businesses that fail. If failures are concentrated in certain geographic areas, liquidation of farm assets may depress land and machinery markets. Severe stress in a region may also precipitate unemployment problems, followed by adverse effects on the tax base and revenue structure of the community.

Public Policies to Alleviate Farm Financial Stress

The direction of government programs has been to shift responsibility for managing risk from the public to the private sector. However, the scope of financial problems in agriculture and potential costs to society in economic and human terms have precipitated discussion of government intervention to alleviate financial stress. Creditors and borrowers, both financially secure and potentially insolvent, have different perspectives on the stress problem and consequently differ on recommendations for financial assistance for stressed farmers. Different solutions may be recommended depending on the perception of who or what is responsible for stress and who is expected to bear the costs of aid.

Several policies have been suggested to minimize social and economic costs associated with liquidating large numbers of farms. These include interest rate buydowns, principal write-offs, loan guarantees, and land holding companies. An interest rate buydown is a program in which the farmer or lender receives an interest subsidy; that is, some portion of interest due is paid by someone other than the borrower. Principal write-offs reduce the amount of outstanding debt for a farm. Loan guarantees by the federal government reduce the potential loss and subsequent risk to the creditor. Land holding companies purchase assets of stressed farmers, thus supporting asset markets and providing funds to the farmer for debt reduction.

An interest rate buydown and a new Congressionally-chartered Capital Corporation to help deal with troubled loans were included in 1985 legislation. Debt moratoriums have also been suggested and foreclosure moratoriums have been applied in some states. FmHA and several states have implemented interest rate buydown programs. Some programs require direct public subsidies while some can be integrated into existing programs and markets.

These programs or other financial policies:

- Buy time for the operator and lender to make needed long term financial adjustments. Farmers can be encouraged to develop realistic reorganization and cash flow projections to stabilize the firms but may need time to implement changes. Financially stressed individuals may want to explore on and off-farm employment opportunities to determine the best use of talents and resources.

- Redistribute the costs of financial stress. Since causes of financial stress include macroeconomic policies and lenders' and farmers' financial practices, it is reasonable to expect the government to share costs of financial stress. Therefore, financial policy should be used to minimize the economic and human costs of adjustments to changing macroeconomic conditions.

Thus financial policy would facilitate change at the microeconomic level rather than substitute for it.

The policy dilemma is in determining how aid can be provided in an efficient, equitable, and effective manner. The financial diversity of the farm population makes an appropriate public policy difficult to formulate and implement. Ideally, policy response should be targeted to problems of financial stress and should facilitate long-term adjustments at minimum cost. With flexible targeted programs, costs of intervention can be contained and public investment can be protected. If some farms are destined to fail because of inefficiencies beyond cash flow problems, it could be a disservice to the operator and lender to keep that farm in operation.

The objective of intervention may influence the selection and use of targeting mechanisms for financial stress alleviation programs. If the objective of a program is to help only those with temporary cash flow problems, targeted programs can, in principle, direct financial aid to individuals with cash flow problems who are not threatened by insolvency. For instance, farms with moderate amounts of remaining equity may be able to correct temporary cash flow problems given either financial aid or time to restructure. If, on the other hand, the primary goal of the public program is to buy time for insolvent or failing farms to sell out, targeted programs can be directed to the farms in the most dire straits.

The amount of subsidy provided by an entity--federal or state government, agricultural lender--may depend partially on the financial resiliency of the entity. Lenders who are financially vulnerable may not be in a position to aid their farm borrowers. Programs in which the state or federal government participates benefit lending institutions, as well as farm operators. Without

government funds, the lender absorbs all interest and principal payment shortfalls as well as debts that must be written off.

Both the scope of the program and the number of eligible recipients help determine the costs of the buydown--the more limited the individual payments and the fewer the number of individuals who qualify, the lower the costs of the buydown to the government or lender providing the buydown. General programs are potentially expensive because of the number of farms eligible, especially if no measures are taken to limit individual payments. Targeting payments to individuals with certain net worth or income characteristics reduces the number of farms eligible for buydowns. Establishing rate or payment maximums within a program limits the amount of buydown going to a single farm.

Conceptual Model

Shifts in asset and debt holdings at the sector level reflect the net national effects of thousands of adjustments at the farm level. To accurately estimate a sector response to a change in economic conditions or policy, microeconomic responses must be adequately embodied in the model. And given the heterogeneity of farm attributes, modeled microeconomic responses must reflect the heterogeneity to be realistic.

Modeling the financial adjustment path of individuals within the agricultural sector requires reliable estimates of cash flow, income, and balance sheets. The financial picture drawn from a farm's financial statements indicates the financial stability and growth potential of the firm. A positive net farm income, together with a positive net cash flow and a modest equity position, provide the foundation for farm expansion or an increase in family living expenditures. A negative cash flow and low owner equity signal the need for changes in the farm operation if it is to remain viable.

The cash flow model for a farm used in this research evolved from our earlier research (Jolly and Doye 1985, 1986; and Doye, 1986). Net cash flow (NCF) for the farm operator family combines farm and nonfarm sources and uses of funds. NCF in this study is expressed as:

$$NCF = R_{op}*(A_o + A_r) - c*A_r - (i+p)*D - CONS + OFI - TAX \quad (1)$$

where R_{op} = cash rate of return to operated assets

A_o = value of owned assets

A_r = value of rented assets

c = cash rental rate on rented assets

i = average rate of interest paid on outstanding debt

p = average rate of principal repayment on outstanding debt

D = level of outstanding debt

CONS = consumption expenditures for the farm family

OFI = off-farm income earned by the operator and spouse

TAX = federal income taxes paid by the farm family.

Farm income, earnings attributable to owned and rented assets, equals $R_{op}*(A_o + A_r) - c*A_r$ and so is a function of the operator's tenure position. Debt financing costs are reflected in the i and p values. CONS and TAX use cash from the operation while OFI contributes cash to the operation. Non-cash costs, capital consumption and depreciation for instance, are not included.

The potential for financial stress as indicated by a negative NCF is particularly acute for farms with no off-farm income. Equation (1) can be manipulated to show that the farm operator with no OFI, $15,000 in family living expenses, no rented assets, and no debt must own assets of $200,000 to project a positive cash flow with cash rates of return of 7.5 percent and must own $272,727 worth of assets if 5.5 percent rates of return prevail.

If net cash flow is negative, the farm family must make changes in the farm's financial structure to meet cash flow demands and reconcile differences between income and expenses. Traditional means of correcting financial problems include debt and asset restructuring, negotiation of debt repayment terms, recapitalization through outside equity infusion, cost control, and improved management.

Financial Restructuring

The amount of financial restructuring necessary for an operator with negative NCF to break even can be derived from the NCF equation:

$$\Delta NCF = B*R_{op}*(A_o + A_r) + (1 + B)*R_{op}*(\Delta A_o + \Delta A_r)$$

$$- c*\Delta A_r - (i + p)*\Delta D - \Delta CONS + \Delta OFI \qquad (2)$$

where ΔNCF = the change in net cash flow required to service all debt and pay for family living expenditures

B = the percentage change in R_{op}

ΔA_o = the change in owned assets occurring in the restructuring process

ΔA_r = the change in rented assets

ΔD = the change in outstanding debt as a result of debt retirement from asset sales or debt discharge by the lender

$\Delta CONS$ = the change in family living expenditures

ΔOFI = the change in off-farm income.

Necessary restructuring can be achieved, theoretically, by a change in any one of the decision variables. To illustrate the effects of various restructuring techniques using an average size farm with an average rate of return, assume a farm operator owns assets valued at $700,000 that earn an average cash rate of return of 6 percent. Farm debts of $200,000 are to be repaid with an average interest rate of 10 percent and a principal repayment rate of 5 percent. The farm family allows $15,000 for family living expenses, earns no off-farm income, and does not rent additional land. Thus the projected NCF is:

$$NCF = .06*(\$700,000) - (.10 + .05)*\$200,000 - \$15,000 = - \$3,000$$

To eliminate cash shortfalls, cash outflows can be reduced by decreasing family living expenditures or reducing production costs. If only the level of family consumption is changed then the change in CONS required, $\Delta CONS$, is:

$$\Delta CONS = NCF. \quad (3)$$

The required reduction in CONS is equal to the cash shortfall, here the negative NCF. For the illustrated farmer, family living expenditures would be reduced by $3,000 (from $15,000 to $12,000) to eliminate the cash shortfall.

Cash receipts might be increased or cash costs reduced through improved resource management, leading to higher rates of returns. The change in R_{op} needed to project a positive cash flow is:

$$\Delta R_{op} = - NCF/(A_o + A_r). \quad (4)$$

In this example, an increase of less than one-half percentage point in the rate of return to operated assets would eliminate the cash shortfall:

$$\Delta R_{op} = \$3,000/\$700,000$$
$$= .0043$$

Off-farm income could be augmented by increasing the hours worked off-farm, changing jobs to receive a higher salary, or ensuring that nonfarm financial investments earn the highest possible rate of return. Thus, a negative NCF could be offset by a corresponding increase in OFI:

$$\Delta OFI = - NCF. \quad (5)$$

For example, an increase in OFI of $3,000 would be needed to break even.

Asset restructuring alternatives include:

1. Changing the amount of owned and rented assets. The number of acres operated could be increased by renting additional land, thus increasing farm income as long as earnings from additional acres exceed rental costs and taxes.

2. Trading low return assets for higher return assets.

3. Giving asset title to the contract holder or lender. Eliminating a debt obligation by giving up an asset with a lien could be a relatively easy way to reduce or eliminate cash flow problems.

4. Selling highly leveraged assets (partial liquidation).

5. Sale-leasebacks of assets.

The assets to be rented or sold to reduce debt to a serviceable level depend on the size of the cash shortfall, the rate of return earned by the assets, the cash recovery rate, rental rates, and debt servicing costs.

If cash income is to be increased by adding rented assets to the operation, then the required change in operated assets is:

$$\Delta A_r = - NCF/(R_{op} - c) \quad (6)$$

Note that adding rented assets is profitable only if R_{op} exceeds c. The change in cash flow associated with an increase in rented assets is equal to $(R_{op} - c)*A_r$. For the farm with a cash shortfall of $3,000, cash income can be increased $3,000 by renting $100,000 of assets if $R_{op} = .06$ and $c = .03$:

$$\Delta A_r = - 3{,}000/(.06 - .03) = \$100{,}000$$

The extent of scaling back of the operation that would occur if the sale of assets were the only means of restructuring is

$$\Delta A_o = NCF/[R_{op} - alpha*(i + p)] \quad (7)$$

where ΔA_0 = assets liquidated

alpha = average cash recovery rate from liquidated assets

$= \Delta D / \Delta A.$

The cash recovery rate, alpha, reflects changes in the market value of assets and market transaction costs such as taxes and broker's fees incurred in the liquidation process. If assets are sold for less than the amount listed on the balance sheet, then the amount of debt that can be retired from the sale of assets is less than a dollar-for-dollar exchange, i.e., alpha is less than one.

The farm operator with assets valued at $700,000 and a cash shortfall of $3,000 would be required to sell $44,444 of assets to break even if the cash recovery rate is 85 percent:

$$A_0 = -\$3,000/[0.06 - .085*(0.10 + 0.05)]$$
$$= \$44,444.$$

The sale of assets reduces the income generating capacity of the farm and results in lost income of $2,667 (or 0.06*$44,444) and thus an addition to the cash shortfall. Since assets valued at $44,444 sell for a lower amount given a cash recovery rate less than one, $37,777 in cash (alpha* A_0) is raised with asset sales. Reducing debt by $37,777 reduces interest and principal due--(0.10+0.50)*D by $5,667. The cash shortfall ($3,000 initially projected plus $2,667 due to reduced income generating capacity) is eliminated.

If assets could be sold and leased back, thus remaining under control of the operator and earning income for the farm, then fewer assets would be sold (assuming the cash rental rate is less than the rate of return to the asset):

$$\Delta A_0 = NCF/[\, c - alpha*(i + p)] \qquad (8)$$

where c is the cash rental rate. A_0 gives the amount of assets that would have to be sold and leased back at a positive net rate of return to meet exactly cash flow needs. Using the example of the farm operator with a cash shortfall of $3,000, if cash rental rates are 5 percent of the asset's value, then

$$\Delta A_0 = -\$3,000/\{0.05 - [0.85*(.010 + 0.05)]\}$$
$$= \$38,710.$$

That is, $38,710 of owned assets would have to be sold and leased back to reduce debt to a serviceable level. Note that future income earnings are lowered by the difference in earnings from owned and rented assets:

$$\Delta NCF = c^*A_r \quad (9)$$

Debt restructuring might involve negotiation with the lender for a longer repayment period, deferred principal or interest payments, addition of unpaid operating loans into real estate mortgages, lower interest rates, or a write-down in outstanding loan principal. If the operator were able to convince the lender to write-down or discharge some of the outstanding debt, the amount of debt that would have to be discharged for the operator to break even is

$$\Delta D = NCF/[-(i + p)]. \quad (10)$$

In our example, the change in debt required is

$$\Delta D = -\$3,000/[-(0.10 + 0.05)]$$
$$= \$20,000.$$

With a write-down of principal from $200,000 to $180,000, interest and principal due is reduced by $3,000, the amount of the cash shortfall. Debt restructuring possibilities may be limited by bank regulations or disincentives to the lender. If credit is imprudently extended to insolvent farm debtors or liquidation is delayed, the total loss to creditors at liquidation may increase.

The feasibility of restructuring alternatives depends on individual circumstances and the initial allocation of resources in the firm. The alternatives are viable only if the opportunity for change exists. In some situations, the farm family that has been financially pressed for several years may have availed themselves of most opportunities to change. If family consumption has already been decreased to a minimum, all debt restructuring possibilities have been exhausted, and rental land is not profitable, then sale of farm assets to retire outstanding debt may be forced on the farm family. If debt and asset restructuring have been attempted and still the farm business is financially failing, total liquidation or bankruptcy can be used to exit farming.

Firm Growth

Farms with cash surpluses, instead of being forced to restructure, may have the opportunity to expand the firm's asset base. From Equation (3), the amount of assets that a firm with a positive cash flow can theoretically acquire is expressed as

$$\Delta A_o = NCF/[(i + p) - R_{op})]. \quad (11)$$

This assumes the operator willingly takes on debt to purchase as many assets as projected income and cash flow allow. A farm with a cash surplus of $3,000, an average rate of return of 6 percent, an average interest rate of 10 percent, and a principal repayment rate of 5 percent could purchase $33,333 in assets:

$$\Delta A_o = \$3,000/[(0.10 + 0.05) - 0.06]$$
$$= \$33,333.$$

Simulation Model

The NCF and restructuring equations specified earlier are used in simulating farm operators' adaptation or response to changes in economic conditions or government policy. Interest payments are assumed to take first priority after rental and family living expenses; principal payments are made from residual income. Principal paid will be less than principal due if NCF is negative.

In the simulation, financial adjustment follows a general sequence that holds for all operators (Figure 2). Individuals with negative NCF restructure assets and/or debt so that interest payments can be made. In each case, the minimum amount of restructuring needed to break even is assumed to occur.

The assumed restructuring process for farms with negative NCF is:

1. OFI is increased. This assumes the operator or some member of the family of working age is initially underemployed and could find an off-farm job or could increase hours worked or salary earned to improve OFI. Or, it could mean that the rate of return on off-farm investments increases.

2. Rates of return (R_{op}) are improved through cost control and improved management.

3. Additional assets are rented to increase farm earnings if rates of return to operated assets exceed cash rental rates.

4. On farms that qualify for financial assistance, proceeds of programs are applied to cash shortfalls. Financial aid programs are directed to farm operators who have made an effort to correct cash flow problems using all means except asset sales and yet are unable to make full interest or principal payments. Operators able to make all interest payments are assumed to be ineligible for financial assistance.

5. Assets are partially liquidated with proceeds from asset sales used to retire debt. If profitable, assets are leased back.

6. Assets are sold and the operator leaves farming if all efforts to restructure fail and the operation shows no immediate potential for a financial turnaround. Lenders are assumed to refrain from foreclosing if the farm is not failing financially.

Farm financial failure in the simulation occurs if any one of these three criteria is met:

1. The current market value of assets is less than outstanding debt, or the debt-to-asset ratio exceeds alpha, the cash recovery rate. These farms are technically insolvent.

2. Assets are completely liquidated to project a positive cash flow.

3. The ratio of NCF to equity is less than - 0.2. A negative NCF of this size would quickly add to debt and erode remaining equity. The farm would be expected to fail within several years.

Farms that are technically insolvent, own no assets, or have severe financial problems as indicated by the NCF-to-equity ratio are assumed to exit the industry at the end of the year in which they are defined as financial failures.

A different series of steps is assumed for operators with a positive cash flow (Figure 2). Federal income taxes are paid. Residual income can then be used to increase family living expenditures at a rate determined by a regional marginal propensity to consume (Richardson, 1981) up to a maximum of $30,000. Cash remaining after taxes and additional family living expenses are paid is invested in farm assets, adding to the income generating potential of the firm.

At year's end, an individual's principal payments are deducted from beginning debt. If restructuring and policy benefits have not generated enough income for the farm to project a positive cash flow, interest or family living expense shortfalls are added to debt. Farms in the survey that fail financially are removed from the sample at the end of the simulated year in which they fail.

NCF calculations for individual operators are summed to determine sample estimates of principal and interest shortfalls and percentages of operators, assets, and debts falling in a particular category. Sector interest shortfalls are estimates of the difference between interest due and interest paid based on the summation of the differences on individual farms. Similarly, principal shortfalls for the commercial farm sector indicate the difference in principal due and principal paid based on the percentage difference projected from the sample. Total credit repayment shortfalls are the sum of interest and principal payment shortfalls. Principal shortfalls are generally larger than interest shortfalls since interest payment is assumed be the priority in the model.

The model looks at the effects of leverage, cash flow constraints, and income on survivability. Hypotheses about economic behavior are based on observations of strategies used by farmers in coping with financial stress. No real decision theory for individuals is involved since the strategies for restructuring do not vary individually. Changes in financial position are restricted to responses to

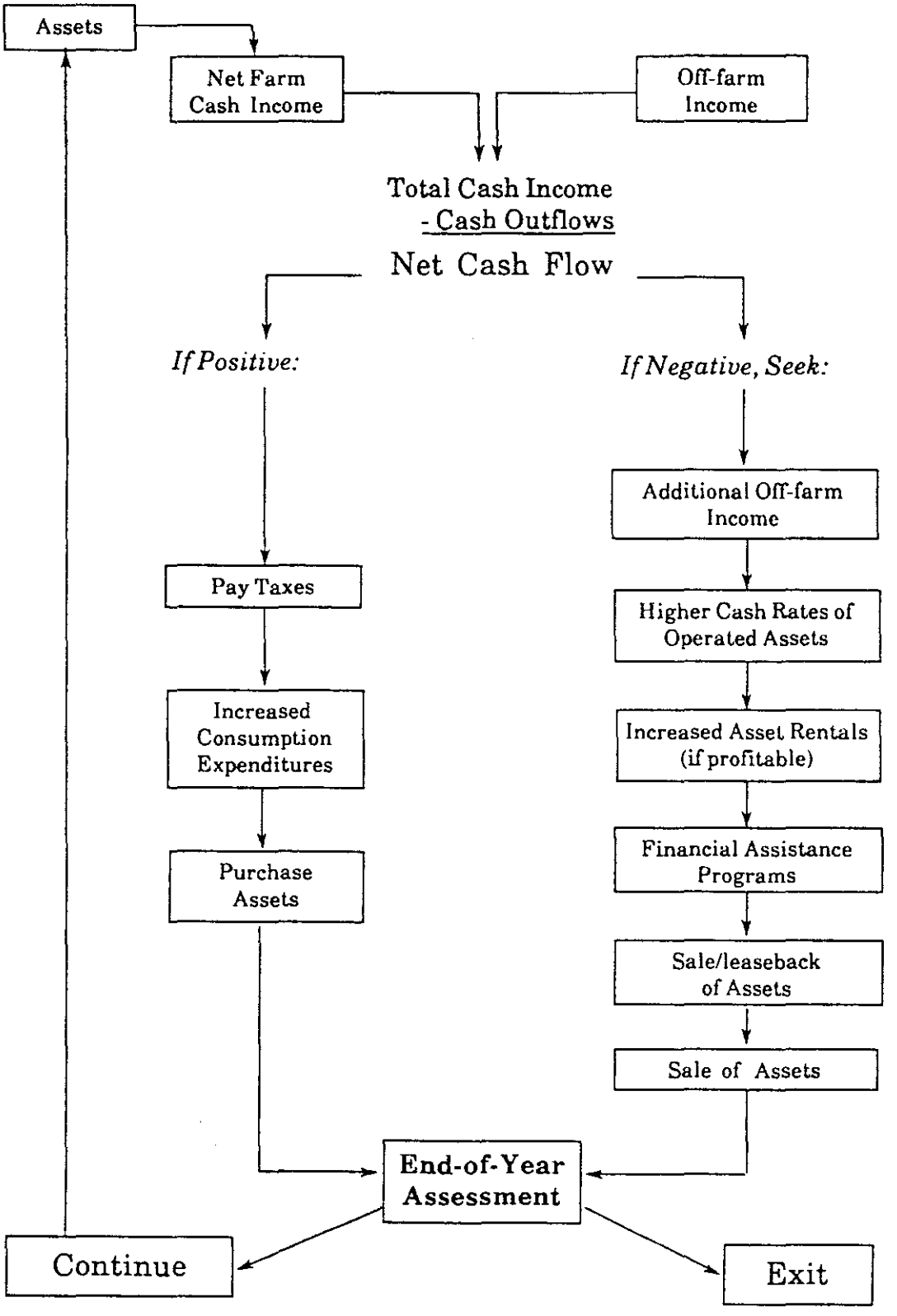

Figure 2. Outline of Model Hierarchy

stress for individuals with negative NCF and to accumulation of assets for operators with positive NCF. Operators do not otherwise change tenancy positions or management procedures in the simulation.

Data and Parameter Estimation

Rather than construct representative farms that reflect typical debt and asset positions for different types and sizes of farms, a sample of U.S. farm operators is used as a basis for analysis. NCF is projected for individual farms using survey values for assets owned, assets rented, debt, and off-farm income. Using actual survey data provides a simple, practical method to embody the heterogeneous attributes of the farm population. Because each operator's current asset holdings and financial position help determine future business opportunities (especially in the short run), beginning with a unique mix of debts, assets, and socioeconomic characteristics representative of individual farm households is important. By typifying farm units or assuming homogeneous firms, responses to financial stress could be grossly miscalculated and costs to individuals would likely be lost in the aggregation.

In the NCF equation, initial values for A_o, D, and OFI are taken from the survey responses. Balance sheet statistics by region and by debt-to-asset ratio for the FJ survey are listed in Table 2. Sample operator, asset, and debt distributions are listed in Table 3.

Assets Rented

FJ sample results indicate the number of acres rented but not the value of acres rented. As a proxy for this value, the number of acres rented was multiplied by an average real estate value, either the farm's average real estate value estimated from survey data or the state average real estate value reported by the Economic Research Service (1984a).

Rates of Return to Operated Assets

R_{op}, the rate of return to operated assets before principal and interest payments, is estimated from income and asset data in the FJ survey along with cash rental rates reported in Farm Real Estate Market Developments: Outlook and Situation Report (Economic Research Service, 1985a):

$$R_o = (FI + c^*A_r)/(A_o + A_r) \qquad (12)$$

where FI = farm income or, gross sales minus cash operating expenses (including land rental expenses).

Costs of production are assumed to be the same on owned and rented land. Differences in income depend on land acquisition cost, either (i + p) for land purchased with borrowed money or c, the cash rental rate, for leased land. The average cash rate of return to operated assets for the United States is 6.58 percent.

Table 3. Estimated Cash Rates of Return to Operated Assets by Region and Size of Operation[a].

Region	Assets Operated (Thousands of Dollars)	Number of Observations in Sample	Cash Rates of Return (R_{op})		
			Year 1[a]	Year 2	Year 3
East	< 450	54	7.56	7.11	6.65
	540-780	55	5.24	4.93	4.61
	> 780	49	4.61	4.34	4.05
South	< 863	59	6.46	6.08	5.68
	> 863	59	5.07	4.77	4.46
Central	<457	54	9.05	8.51	7.96
	457-730	54	7.57	7.12	6.66
	730-1,239	54	7.33	6.89	6.45
	> 1,239	54	5.46	5.14	4.80
West	< 586	60	6.63	6.24	5.83
	586-1,019	60	5.96	5.61	5.24
	1,019-1,964	60	4.85	4.56	4.27
	> 1,964	59	3.19	3.00	2.81

[a] Rates of return for year 1 are estimated from FJ sample data.

R_{op} averages are estimated by region (East, South, Central, and West) and by size of farm in an attempt to develop relatively homogeneous groups for which income aggregation bias is minimized (Table 3). In all regions, as the size of operation increased average Rop declines. This result is somewhat unexpected since most studies of farm income show constant or increasing returns to size. Declining average rates of return could reflect decreasing income per unit or increasing costs per unit, perhaps due to labor and management constraints. Another explanation is that smaller farms are different from larger farms. For instance, livestock farms might be smaller than crop farms in assets operated and might generate higher rates of return. Finally, some previous studies may attribute income earned by rented assets to owned assets, thus overstating income for owned assets and farm size.

In projections over time, rates of return are tied to Food and Agricultural Policy Research Institute projections of cash income before interest. Rates of return for a given farm are assumed to decline at the same rate as projected net cash income before interest for the sector.

Off-farm Income

OFI for commercial operators in the FJ sample averaged $8,000. The average OFI figure declined as farm size, measured by gross sales from farm products, increased. For farms with sales of $40,000-$100,000, the mean OFI figure was $10,295. Farms with sales of more than $500,000 reported an average of $4,290 OFI. This contrasts with USDA statistics (Economic Research Service, 1985b), which show OFI increasing from $9,298 for farms with sales of $40,000-$100,000 to $14,126 on farms with sales exceeding $500,000.

Cash Rental Rates

Cash rental rates are estimated from the Agricultural Land Values and Markets Outlook and Situation Report (Economic Research Service, 1985a) for ten production regions used by the USDA: Northeast, Lake States, Corn Belt, Northern Plains, Appalachia, Southeast, Delta, Southern Plains, Mountain, and Pacific. Rental rates are expressed as a percentage of land value (Table 4). The rates range from 3.2 percent in the Northeast to 8.3 percent in the Northern Plains. When used in the model for projections over time, cash rental rates remain the same, or decline if they exceed R_{op} to one percentage point less than the cash rate of return. Although many of the farms may have "share rents", there are no regional statistics on average costs per acre so cash rental rates are used as a best estimate of rental costs.

Cash Recovery Rates

Alpha, the cash recovery rate, determines the market value of farm assets when sold and is based on the change in farm real estate values reported by the USDA (Economic Research Service, 1985a). Alpha values used in the model are listed in Table 6. In the first year alphas ranged from 95 percent in the East to 76 percent in the Central region. In projections over time, the cash recovery rate was assumed to decline by 10 percentage points from the original value in the second year and an additional 5 percentage points from the original value in the third year of the projection. Thus, moderate declines in land values (or increases in transactions costs) are assumed for 1986 and smaller declines are assumed for 1987. When a land holding company is in place, land values are assumed to be stabilized by the ready buyer, and cash recovery rates are constant over time.

Interest and Principal Repayment Rates

Since maturities and other terms of existing debt on surveyed farms are not known, the average interest rate and principal repayment rates are set at a constant 10 percent and 5 percent, respectively. The 5 percent principal repayment rate implies that the average life of all loans not repaid in the year in which they are made is 20 years. For example 1) 75 percent of an operator total debt is intermediate or long term debt with the other 25 percent to be repaid in the current year and 2) one-third of intermediate and long term debt (25 percent of the total) is intermediate debt with a term of seven years and the remaining two-thirds (50 percent of the total) is long term debt debt with a term of 35 years, then the average principal repayment rate is .25/7 + .50/35 = .05.

Family Living Expenses

Family consumption expenditures are assumed to be a minimum of $15,000 in all cases. For farms with a positive cash flow, family living expenses can increase up to a maximum of $30,000 at rates determined by regional marginal propensities to consume (Richardson, 1981). Regional marginal propensities to consume are listed in Table 4 and range from 14.1 percent in the Lake States to 56.2 percent in the Mountain States.

Table 4. Estimated Cash Rental Rates, Cash Recovery Rates, and Marginal Propensities to Consume by Region (percent)

U.S.D.A. Region	Cash Rental Rates[a]	Cash Recovery Rates			Marginal Propensity to Consume[b]
		Year 1	Year 2	Year 3	
Northeast	3.20	94.09	84.09	79.09	41.8
Lake States	6.53	81.00	71.00	66.00	14.1
Corn Belt	7.36	75.60	65.60	60.60	24.6
Northern Plains	8.33	77.00	67.00	62.00	39.9
Appalachia	3.75	91.00	81.00	76.00	43.6
Southeast	4.17	95.50	85.50	80.50	40.4
Delta	5.80	91.00	81.00	76.00	17.5
Southern Plains	3.92	85.50	75.50	70.50	18.8
Mountain States	4.72	89.87	79.87	74.87	56.2
Pacific	5.31	89.67	79.67	74.67	23.1

[a] Cash rental rates are expressed as a percent of asset value.
[b] Richardson, 1981.

Taxes

Federal income tax estimates are made only for operators with positive NCF. Other operators are assumed to have no federal income tax liability. Taxable income for the farm in the computer program is defined as farm income less rental and interest expenses and deductions plus OFI. Tax rates taken from 1985 Package X tables (Department of the Treasury, 1985). Four dependents were assumed for operators less than 45 years old or more than 65 years old; two dependents are assumed in other cases.

Sector Estimates of Operators, Assets, and Debts on Commercial Farms

Values for assets owned and debt held by commercial operators play an important role in this study. Sector values for assets and debts are applied to sample percentages estimated through simulation to determine magnitudes of interest and principal shortfalls and volumes of assets sold and debt liquidated. The total number of commercial farm operators based on USDA estimates is 636,456 (National Economics Division, 1985b).

Average balance sheets from the FJ survey imply a sector value of $127 billion for debt ($199,726 per farm X 636,456 commercial farms) and $458 billion for assets ($719,540 per farm X 636,456 commercial farms). This method of estimating aggregate values is consistent with underlying sample values. Sector values for assets and debts estimated from the FJ sample are applied to regional percentage distributions to get regional values. Regional percentage distributions of commercial operators, assets, and debts are based on FCRS results (Baum, 1985). Table 5 lists the percent and number of commercial operators by region and the percent and value of assets and debts by region.

Simulation Results

The simulation program was designed to estimate likely magnitudes of restructuring in the agricultural sector resulting from efforts of individuals to achieve a positive or break even cash flow. A number of scenarios were developed to examine the impact of various restructuring options--changes in off-farm income, rates of return earned, amount of assets owned and rented--on debt servicing capability (Doye, 1986). The results reported here focus on two scenarios. In the first "worst case" scenario, the only means of restructuring available to farms with a negative NCF is sale of assets. In the second scenario (the baseline scenario), limited changes can be made in the amount of off-farm income earned, rates of return to assets, and the amount of assets rented to improve cash flow. The baseline scenario (BASE) is used in interest rate and rate of return sensitivity tests, in projections over time of restructuring without public intervention, and in simulation of financial stress alleviation programs.

Table 5. Sector Estimates of Operators, Assets, and Debts of Commercial Farms by Region.

	East	South	Central	West	U.S.
Operators					
Percent[a]	8.2	23.8	55.5	12.6	100
Number	52,126	151,222	353,233	79,939	636,456
Assets					
Percent[a]	5.9	25.6	47.4	21.1	100
Amount ($B)	27	117	217	98	458
Debt					
Percent[a]	5.1	19.4	55.8	19.8	100
Amount ($B)	6	25	71	25	127

[a]Baum, 1985.

In the results, asset percentage figures are expressed as a percent of total sample assets, debt figures as a percent of total sample debt, and operator figures as a percent of total sample operators within a region. The sample percentages are multiplied by sector estimates of the number of commercial operators and the value of assets and debts owned by them to project number of operators or dollar value of assets and debts in a given category.

Statistics reported in simulation results are defined as:

1. The percent of assets sold includes assets sold by farms that fail financially and assets sold by farms as part of the restructuring process.

2. The percent of debt liquidated is debt held by financially failing farms and debt retired as part of the restructuring or repayment process.

3. Debt written off is the remaining debt after proceeds from asset sales are applied to debt retirement on financially failing farms.

4. The percent of operators selling out shows the fraction of total operators who operate financially failing farms, that is, farms that cannot be restructured.

5. The percent of operators scaling back includes operators who sell assets to reduce debt but maintain ownership of at least some assets.

6. Operators with negative NCF before selling assets is the sum of operators selling out and operators scaling back to project a positive cash flow.

7. The percent of operators with negative NCF after restructuring indicates the percent of operators unable to meet all financial obligations even after restructuring. It is the percent of operators selling out or the percent of operators with financially failing farms.

8. The percent of operators with positive NCF after restructuring indicates the portion of the population that is able to pay all current obligations through restructuring.

Restructuring through Unlimited Asset Sales

Table 6 gives estimated national restructuring requirements needed for commercial farms to achieve some sustainable financial position assuming the only individual farm adjustment that can be made is partial or complete asset liquidation. For farms with negative NCF, debt is written off if the value of assets owned is less than outstanding debt. Because of the focus on short run financial problems, the objective of financial adjustment is assumed to be a positive net cash flow. In the longer run, income levels would have to be sufficient to replace capital and allow for savings or risk reserves.

Estimates of total restructuring needs of the agricultural sector in Table 6 provide a "worst case" scenario in which operators, because of market conditions or individual circumstances, cannot improve their financial position through changes in management, off-farm employment, or negotiations with the lender. The only alternative for farms with negative NCF is to sell assets and use the proceeds to eliminate cash shortfalls. Cash proceeds from liquidation of assets after all transactions costs are equal to the cash recovery rate times the balance sheet value of the assets sold.

Since restructuring requirements are influenced by rates of return to farm assets, results are presented in a sensitivity table. Three cash rates of return to operated assets and cash recovery rate scenarios are simulated. A simple capitalization formula can be used to show that the cash recovery rate (alpha) changes in direct proportion to changes in rates of return to the asset (R_{op}). Hence the assumed percentage changes in alpha and Rop are equivalent. The scenario with high rates of return to operated assets and high cash recovery rates uses rates that are 10 percent higher than the expected rates listed in Tables 3 and 4. The low return, low cash recovery rate scenario uses rates that are 10 percent lower than the expected rates.

Table 6. Liquidation Required to Service Remaining Debt from Projected Cash Flows Under Different Cash Recovery Rate and Rate of Return Assumptions in "Worst Case" Scenario (percent).

Region	Assets Sold	Debt Liquidated	Debt Written Off	Operators Selling Out	Operators Scaling Back	Operators with Negative NCF	Assets Purchased
	High Rates of Return to Operated Assets, High Cash Recovery Rates						
East	5.8	29.8	0.8	1.9	27.9	29.8	11.6
South	5.7	28.1	2.1	6.8	27.1	33.9	15.1
Central	24.4	63.0	4.3	13.9	31.9	45.8	16.3
West	15.1	60.1	0.8	3.4	37.2	40.6	9.0
U.S.	16.6	54.0	3.0	9.6	31.4	41.0	14.1
	Expected Rates of Return to Operated Assets, Expected Cash Recovery Rates						
East	8.1	38.2	1.1	3.2	31.0	34.2	9.8
South	8.1	35.4	2.7	9.3	27.1	36.4	12.6
Central	32.2	77.1	7.7	19.0	33.8	52.8	13.0
West	19.4	69.7	1.1	5.4	39.3	44.8	7.5
U.S	21.9	65.6	5.1	13.4	33.0	46.4	11.5
	Low Rates of Return to Operated Assets, Low Cash Recovery Rates						
East	11.6	48.7	1.6	5.1	37.3	42.4	8.1
South	11.7	45.3	3.5	13.6	34.8	48.3	10.4
Central	40.9	89.1	10.1	20.8	40.3	61.1	10.5
West	24.5	79.1	1.8	9.2	40.6	49.8	6.0
U.S	28.2	76.6	6.8	16.1	39.1	55.1	9.4

Although 46 percent of operators are projected to have negative NCF, similar projections by Jolly et al. (1985) indicate 43 percent of commercial farms have negative cash flows. Restructuring requirements for the Central region are much more severe than the national average 1 (Table 6). With expected rates of return and cash recovery rates nearly one-third of the assets of commercial operators are sold and more than three-fourths of the debt are liquidated in the Central region. More than 50 percent of operators have a negative cash flow and almost 19 percent must liquidate all assets to project a positive cash flow.

In the simulation, all U.S. operators with a negative NCF sell assets to achieve a positive cash flow, either scaling back or selling out. Given expected rates of return and cash recovery rates, approximately 22 percent of the nation's commercial agricultural assets are liquidated for all operators to eliminate cash shortfalls (Table 6). Only half of assets liquidated can be purchased by other commercial farms given their capacity to expand and service debt. Two-thirds of the outstanding debt (65.6 percent) of commercial operators is retired, assumed by purchasers, or discharged following liquidation of failing farm businesses.

More than 13 percent of U.S. operators liquidate all assets to resolve debt and cash flow problems. It should be noted that estimates of the number of operators selling out due to farm failures is quite sensitive to the technical insolvency criterion. Since one criterion for farm failure is a debt-to-asset ratio greater than the cash recovery rate, assumptions about current market value of assets help determine the number of farm failures. If, rather than using the cash recovery rate as the determinant of technical insolvency, a debt-to-asset ratio greater than one is used (a conservative criterion), the number of financially failing farms drops from 13 percent to approximately 7.4 percent nationally. The USDA estimate of the percent of commercial farms with debt-to-asset ratios exceeding one is lower at 4.8 percent (Jolly et al., 1985).

Lower rates of return and cash recovery rates reduce the ability of farmers to service debt and increase the potential volume of liquidated assets. The combined impact of higher incomes and cash recovery rates is to improve cash flow, increase the debt servicing capability of the farm operator, and reduce the amount of assets sold to retire debt (Table 6). These results indicate the magnitude of transition expected and demonstrate the sensitivity of results to assumed rates of return and cash recovery rates. Most financially stressed operators can attain a positive cash flow by scaling back (33/46 or 71 percent). With higher rates of return, the ability of financially stressed operators to service debt improves as does the ability of financially stable operators to purchase assets. But, even with optimistic income expectations, large amounts of assets and debts change hands when sale of assets is the only restructuring option.

The assets sold to project a positive cash flow--an estimated $101 billion or 22 percent of $458 billion--indicate the total restructuring needs of the agricultural sector. Even if these asset sales are distributed over several years, the required rate of sales greatly exceeds historical sector annual average asset turnover rates. If the sales occur over five years, more than $20 billion in assets will be sold each year when, in 1984, farmland purchases were slightly more than $6 billion (Economic Research Service, 1985a).

Restructuring requirements may be underestimated if assumptions that land values are maintained and that markets continue to function are not reasonable. The volume of assets changing hands when financially stressed farms sell assets

suggests that market failure could occur and that assets would not sell. These results indicate the need for buying time for operators to restructure using existing markets. They also provide reason for public programs to ease farm transition, possibly preventing agricultural market failures.

Baseline Scenario

Results from the baseline (BASE) simulation indicate likely magnitudes of restructuring when moderate adjustments can be made at the farm level to improve cash flow before assets are sold. This scenario assumes that some potential for improvement in financial management at the microeconomic level exists. In the baseline scenario, farm operators are assumed to be able to:

1. Increase OFI by 5 percent or to $3,500 or to the point at which net cash flow is positive, whichever is least. Previous simulations showed that this allowance does more to improve cash flow than a 10 percent increase in OFI (Doye, 1986). Apparently a significant number of farms in the sample with negative cash flows have no OFI or very little OFI initially. Thus, a small OFI sum does more to improve the farm's finances than a large percentage increase in the initial OFI.

2. Increase R_{op} by 10 percent or to the point at which NCF is positive, implying that net cash income before principal and interest payments can be increased by 10 percent through cost control and improved farm management. A farmer who owns and operates assets valued at $700,000 with a 6.5 percent rate of return has a projected farm income of $45,500. A 10 percent increase in the rate of return yields an increase of $4,550 in farm income. If the farmer operates 700 acres, the 10 percent increase in R_{op} is equal to an increase in income of $6.50 per acre.

3. Increase assets rented by an amount not to exceed 10 percent of assets operated. A larger operated asset base allows farm operators in regions where estimated rates of return to operated assets exceed cash rental rates to generate more income. Additional income can be used to service debt or cover family living expenditures.

Allowing moderate increases in OFI, R_{op}, and A_r reduces of sector-level assets and debts liquidated and operators selling out (Table 7). Asset sales are not initially included as part of the restructuring process because selling assets is a more drastic measure. Given the projected assets sold with the exit of failing farms, it is assumed that farms that can survive will retain ownership of assets in hopes of stabilizing the operation or receiving higher prices for the assets when sold.

Table 7. Regional Differences in Expected Restructuring for Year 1 of BASE Scenario with No Intervention, United States.

	East	South	Central	West	U.S.
Assets Sold					
Percent	3.4	3.4	10.1	6.3	7.2
Amount ($B)	0.929	3.990	21.809	6.194	32.839
Debt Liquidated					
Percent	15.2	15.3	29.3	20.2	24.0
Amount ($B)	0.913	3.813	20.775	5.050	30.531
Debt Written Off					
Percent	1.7	3.4	9.0	2.2	6.2
Amount ($B)	0.101	0.850	6.397	0.548	7.887
Operators Selling Out					
Percent	5.7	12.7	15.3	9.6	13.2
Amount ($B)	2,969	19,223	53,966	7,693	83,821
Operators with Negative NCF Before Intervention					
Percent	22.8	25.4	38.4	37.2	33.9
Number	11,874	38,441	135,747	29,769	215,822
Interest Shortfall ($B)	$0.047	$0.238	$1.505	$0.673	$2.464
Principal Shortfall ($B)	$0.112	$0.413	$2.258	$0.840	$3.620
Total Shortfall ($B)	$0.158	$0.650	$3.763	$1.513	$6.083
Assets Purchased					
Percent	9.8	12.6	13.0	7.5	11.5
Amount ($B)	2.633	14.707	28.102	7.321	52.716

Regional Results of BASE Run

From the BASE run, regional differences in numbers of operators in a given category and in restructuring needs are estimated (Table 7). Because commercial farms are concentrated in the Central region, nearly half of the assets sold and two-thirds of the agricultural debt retired through U.S. farm financial failures occurs in the Central region. More than half of the total debt repayment shortfalls are in the Central region.

The assets purchased figure (Table 7) indicates the sector's potential to absorb agricultural asset sales within the sector. It reflects the ability of solvent operators to purchase assets based on their current cash flow and equity

position.[2] The figure reported may represent an upper bound since it assumes all farmers would use debt to purchase assets when, in fact, many operators prefer not to use credit to expand their operations. It also assumes that regardless of the age of the farm operator or his desire to retire, if finances permit, he will purchase assets.

Assets sold by failing commercial farms could theoretically bepurchased by existing commercial farms in all regions. The percent of assets that could be purchased exceeds the percent of assets sold as insolvent operators exit the industry. The differential between assets purchased and assets sold is relatively small in the Central and West--3 percent in the Central region and 1 percent in the West.

Sensitivity of BASE Results to Cash Rates of Return

Table 8 indicates sensitivity of results to assumptions about prevailing cash rates of return to operated assets. The three columns show projections under low, expected, and high rates of return. As in earlier results, low rates of return are 90 percent and high rates of return are 110 percent of expected rates of return. Low rates of return (LBASE) increase estimated interest shortfalls by about $1 billion and principal shortfalls by about $0.5 billion. Conversely, high rates of return reduce interest shortfalls by $1 billion and principal shortfalls by $0.5 billion.

Although higher average rates of return to operated assets benefit all farms, the farms with positive cash flows because of higher rates of returns are those that were experiencing moderate and not severe financial stress. The farmers near breakeven are most affected by changes in economic conditions and the biggest impact is on their ability to make interest payments. Insolvent farmers or those near insolvency are rarely rescued by either improved returns or moderate restructuring efforts. Higher rates of return to failing farms merely reduce losses to the lender in debt and interest written off. Changes in returns to the farm sector also affect the purchasing power of solvent operators by influencing their ability to use and service debt.

Sensitivity of BASE Results to Interest Rates

Sensitivity to changes in the assumed interest rate are demonstrated in Table 9 for the BASE run. Average interest rates of 8 and 12 percent are compared to the BASE assumption of 10 percent. The range for the percent of operators with cash shortfalls is 30 to 39 percent for interest rates of 8 to 12 percent. Using

[2]The calculation is made using Equation (10) for theoretical asset purchases.

Table 8. BASE Scenario Sensitivity to Rate of Return Assumption, United States.

	Lower R_{op}	BASE	Higher R_{op}
Assets Sold			
Percent	8.1	7.2	6.4
Amount ($B)	37.073	32.829	29.083
Debt Liquidated			
Percent	26.4	24.0	22.1
Amount ($B)	33.576	30.537	28.027
Debt Written Off			
Percent	6.8	6.2	5.7
Amount ($B)	8.671	7.880	7.202
Operators Selling Out			
Percent	15.4	13.2	11.7
Number	98,272	83,851	74,710
Operators with Negative NCF After Restructuring			
Percent	43.9	33.9	28.1
Number	279,542	215,824	178,926
Operators with Positive NCF Because of Restructuring			
Percent	11.2	12.5	12.9
Number	71,277	79,315	82,184
Interest Shortfall ($B)	$3.518	$2.464	$1.664
Principal Shortfall ($B)	$4.115	$3.620	$3.048
Total Shortfall ($B)	$7.633	$6.083	$4.712
Assets Purchased			
Percent	9.4	11.5	14.1
Amount ($B)	42.915	52.716	64.761

average interest rates of 8 rather than 10 percent in the simulation, interest and principal shortfalls are projected to be $4.75 billion, or $1.3 billion lower than the BASE. Higher interest rates of 12 percent imply a $1.7 billion increase in total shortfall from the BASE shortfalls to $7.8 billion. Changes in interest rates above or below the mean of 10 are apparently not symmetric. Higher interest rates increase the repayment shortfalls of stressed farmers more than lower interest rates reduce cash shortfalls.

Table 9. BASE Scenario Sensitivity to Interest Rate Assumption, United.States.

	Interest Rate		
	i = 8	BASE i = 10	i = 12
Assets Sold			
Percent	6.1	7.2	8.7
Amount ($B)	27.709	32.839	39.617
Debt Liquidated			
Percent	21.2	24.0	27.8
Amount ($B)	26.873	30.531	35.331
Debt Written Off			
Percent	5.7	6.2	6.9
Amount ($B)	7.233	7.887	8.725
Operators Selling Out			
Percent	11.8	13.2	15.1
Number	75,346	83,821	96,329
Operators with Negative NCF Before Intervention			
Percent	30.1	33.9	39.0
Number	191,319	215,822	248,409
Interest Shortfall ($B)	$1.461	$2.464	$3.785
Principal Shortfall ($B)	$3.289	$3.620	$4.013
Total Shortfall ($B)	$4.750	$6.083	$7.798
Assets Purchased			
Percent	15.8	11.5	9.0
Amount ($B)	72.547	52.578	40.991

Restructuring Requirements Over Time Using BASE Scenario

Table 10 provides estimates of changes in asset and debt holdings over time using the BASE scenario. Asset sales are allowed only with the exit of failing farms. Some farms not failing may have negative NCF at the end of the year. Hence, the results show movement toward an equilibrium rather than the end results of restructuring. Rates of return and cash recovery rates are assumed to decline over time (Tables 3 and 4). Total commercial operator debt in the second year is assumed to equal total commercial operator debt in the first year less debt liquidated in the first year. Total debt for the third year is calculated similarly.

Table 10. Expected Changes Over Time in Response to Financial Stress with BASE Scenario, United States.

	Year 1	Year 2	Year 3
Assets Sold			
Percent	7.2	3.1	2.8
Amount ($B)	32.839	14.152	12.641
Debt Liquidated			
Percent	24.0	9.3	8.7
Amount ($B)	30.531	8.981	7.594
Debt Written Off			
Percent	6.2	0.4	0.4
Amount ($B)	7.880	0.415	0.306
Operators Selling Out			
Percent	13.2	3.0	2.2
Number	83,821	16,358	11,852
Operators with Negative NCF Before Intervention			
Percent	33.9	21.0	22.1
Number	215,822	116,219	118,464
Interest Shortfall ($B)	2.464	0.415	0.341
Principal Shortfall ($B)	3.620	1.736	1.365
Total Shortfall ($B)	6.083	2.151	1.706
Assets Purchased			
Percent	11.5	11.5	10.7
Amount ($B)	52.716	52.578	48.823

Since no attempt is made to model the asset purchasing patterns of solvent and financially stable operators, the value of total commercial operator assets is assumed to remain constant over time. This implies that assets sold as part of the restructuring or liquidation process are purchased by other commercial farm operators, so assets owned by commercial farm operators remain constant.

The largest transition occurs in the first year when a large number of insolvent operators sell out. Only 3 percent of remaining operators are technically insolvent or financial failures in the second year. Even fewer farms are classified as insolvent or failing the third year. Under these conditions and with the most stressed farms quitting earlier, 22 percent of operators have negative NCF in the third year. Interest shortfalls drop off dramatically after the

first year, but principal shortfalls remain significant even after 3 years of limited restructuring.

BASE Scenario with Unlimited Asset Sales

Table 11 gives national restructuring requirements for commercial farms attempting to correct cash flow problems using BASE scenario assumptions in conjunction with unlimited asset sales. As in Table 6, a sensitivity table format is used that incorporates three cash rates of return and cash recovery rates. The rates are the same as those used in Table 8--high and low values are 10 percent higher or lower than expected rates of return and cash recovery rates.

Comparisons of results in Tables 6 and 11 indicate the reduction in operator, asset, and debt liquidations with moderate adjustments prior to asset sales. Although liquidations are reduced, the magnitudes of required liquidation are still quite high. Given expected rates of return and cash recovery rates, 12 percent fewer operators have negative net cash flows. One-fourth of the operators with negative NCF initially now project a positive cash flow. One-third fewer operators are expected to sell out because of financial failure.

Approximately 17 percent of the commercial agricultural sector's assets are sold compared to 22 percent (Table 6). Assets potentially purchased by solvent operators do not change since the financial position of nonstressed operators does not change with the availability of restructuring alternatives.

The amount of debt liquidated falls from 66 percent (Table 6) to 51 percent (Table 11) with BASE assumptions and unlimited asset sales. Thus, the availability of off-farm work and the ability to increase farm income by moderate amounts can reduce the total volume of debt liquidated by a substantial amount. Debt written off decreases from 5.1 to 3.7 percent.

Our analysis suggests some justification for considering financial policy initiatives. Results indicate that moderate improvements in the returns to agriculture and decreases in average interest rates charged on outstanding debt will reduce, but not eliminate, the immediate need for large scale liquidation of debts and assets. More assets may be liquidated to stabilize the agricultural sector than asset markets can efficiently handle in the short run.

Guaranteed Loans with Debt Adjustment

In 1980, a debt adjustment program for guaranteed operating loans and farm ownership loans was implemented. The program was designed to provide credit to family farms who did not have adequate loan security without debt adjustment. To participate in the program, lenders were required to write-down

Table 11. Liquidation Required to Service Remaining Debt from Projected Cash Flows Under Different Cash Recovery Rate and Rate of Return Assumptions in BASE Scenario (percent)

Region	Assets Sold	Debt Liquidated	Debt Written Off	Operators Selling Out	Operators Scaling Back	Operators with Negative NCF	Assets Purchased
	High Rates of Return to Operated Assets, High Cash Recovery Rates						
East	3.2	17.2	0.8	1.3	15.8	17.1	11.6
South	3.3	16.5	1.3	3.4	16.9	20.3	15.1
Central	17.5	45.8	3.3	7.4	24.5	31.9	16.3
West	11.9	47.7	0.7	2.5	30.5	33.1	9.0
U.S.	11.8	39.0	2.3	5.3	22.8	28.1	14.1
	Expected Rates of Return to Operated Assets, Expected Cash Recovery Rates						
East	4.8	23.0	1.0	1.9	20.9	22.8	9.8
South	5.5	23.9	2.4	7.6	17.8	25.4	12.6
Central	24.7	59.5	5.3	12.0	26.4	38.4	13.0
West	16.1	58.4	1.0	3.4	33.9	37.2	7.5
U.S	16.7	50.6	3.7	9.1	24.8	33.9	11.5
	Low Rates of Return to Operated Assets, Low Cash Recovery Rates						
East	7.3	31.7	1.4	3.2	24.7	27.9	8.1
South	7.9	32.2	3.0	9.3	22.0	31.4	10.4
Central	33.8	76.1	9.2	15.7	36.1	51.9	10.5
West	21.3	69.3	1.6	5.0	38.1	43.1	6.0
U.S	23.0	64.0	6.1	11.5	32.4	43.9	9.4

existing indebtedness so the new guaranteed loan would show a positive cash flow. The write-down by the lender could be taken in several ways:

1. A write-off of at least 10 percent of existing debt.

2. A reduction in the interest rate equivalent in present value terms to a 10 percent debt write-off.

3. A combination of a debt write-off and an interest rate reduction. Although loan guarantees are now made without requiring debt adjustment, an attempt is made through simulation to estimate the value of a debt adjustment program.

Model Specification

In the computer program, all operators unable to pay interest fully are assumed eligible to apply for a debt adjustment. A loan guarantee is provided if, with a 10 percent write-down of principal, the farm operator is able to show a positive cash flow. The value of the simulated loan guarantee with debt adjustment in alleviating financial stress is quite limited. None of the stressed operators in the sample qualified for the program. The addition to cash flow (or reduction in cash outflow) from the 10 percent reduction in principal and interest repayment did not provide enough change for operators to improve substantially the financial condition of the farm. These simulation results suggest reasons for observed low participation rates in the debt adjustment program.

Two constraints contribute to these results: 1) an assumption of the model and 2) the program eligibility criterion. The model limits the number of eligible farmers by stipulating that only farmers who cannot fully pay interest are eligible for financial aid. Thus, operators with negative NCF because of principal payment shortfalls only are not eligible for assistance. The second constraint is the loan guarantee program requirement that firms show a positive cash flow after the principal write-down. This constraint is apparently limiting for all eligible farms.

Interest Rate Buydown Programs

Interest buydown programs are intended to provide immediate relief to financially stressed farmers because they provide income subsidies for interest shortfalls in general, and may be broadened to cover other cash shortfalls. They aid in meeting current expenses so income generating capabilities are not impaired. These subsidies help reduce interest accumulation while the operator attempts debt or asset restructuring.

A buydown that is not limited to the amount of interest shortfall may provide cash for principal repayment or consumption expenditures. This type of program lacks limits on intervention costs to protect the public's investment. The taxpayer may bear the costs of not only buying time for the farmer by preventing interest accumulation but also may assist in paying off debt and family living expenditures. In other words, since the subsidy is large enough to pay interest and principal, the farm's equity can increase as a result of the program.

Four interest buydown programs are evaluated in this section. The first is an FmHA-type buydown, a general buydown not limited to interest shortfalls but limited by maximum rates as established by the government and lender. The second alternative is a two-way buydown by the federal government and lender limited to interest payment shortfalls. The third program is targeted buydown and the fourth program is a buydown with a payment limitation. In each of the simulations, BASE assumptions regarding limited farm level restructuring are used in conjunction with policy specific criteria and assumptions. Costs of administering various programs are not estimated. Targeted programs might be more costly to administer than a general buydown because a farmer's eligibility for a program would have to be determined.

Two-way Interest Rate Buydown Not Limited to Interest Shortfalls

FmHA has been directed to aid lenders in providing credit to family farm operations with quaranteed loans who are temporarily unable to project a positive cash flow without a reduced interest rate. Lenders that participate in the program agree to reduce the interest rate paid on a loan or line of credit. In return, FmHA agrees to make annual interest rate buydown payments to the lender in an amount not to exceed 50 percent of the cost of reducing the interest rate on the loan or 2 percentage points. The FmHA buydown is not limited to the interest shortfall and so may provide cash for principal repayment or consumption expenditures.

Model Specification. Since the FJ survey data provide no information on the amount of debt owed by an individual to a particular institution, the buydown was allowed for all individuals unable to make interest payments. Thus, any farmer with a cash shortfall exceeding principal due is eligible for an interest rate buydown. The federal government reduces interest rates by half of the points required for the farm to show a positive cash flow, or at most 2 points. The lender buys down interest rates by half the points required to project a positive cash flow, if less than 4 points.[3] Thus, average interest rates can be reduced by a maximum of 6 basis points. The maximum on effective buydown rates for both the federal government and the lender limit each entity's liability.

Results. In the first year of the program, recipients of the buydown receive an average payment per farm of $24,294 (Table 12), calculated as total program costs divided by the number of operators who qualify for aid. More than two-thirds of operators with negative NCF qualify for this buydown. One-third do not

[3] A maximum for the bank's buydown was not included in legislation but was included in the simulation to protect the bank's investment.

Table 12. Expected Changes Over Time with a FmHA-type Interest Rate Buydown, United States.

	Year 1	Year 2	Year 3
Assets Sold			
Percent	5.6	1.3	1.9
Amount	25.648	5.757	8.818
Debt Liquidated			
Percent	19.9	3.9	5.9
Amount	25.306	3.98	5.77
Debt Written Off			
Percent	5.1	0.2	0.3
Amount	6.419	0.15	0.28
Operators Selling Out			
Percent	10.8	1.1	1.6
Number	68,533	6,390	9,007
Operators with Negative NCF Before Intervention			
Percent	33.9	20.5	21.7
Number	215,822	115,644	121,096
Operators with Negative NCF Who Qualify for Aid			
Percent	67.6	32.3	29.8
Number	145,853	37,352	36,135
Total Costs ($B)	3.543	1.322	1.427
Federal Costs ($B)	1.194	0.447	0.489
State Costs ($B)	0.000	0.000	0.000
Lender Costs ($B)	2.350	0.875	0.938
Average Payment Per Farm	$24,294	$35,394	$39,480
Interest Shortfall ($B)	0.368	0.010	0.010
Principal Shortfall ($B)	2.184	1.017	0.831
Total Shortfall ($B)	2.553	1.027	0.840
Assets Purchased			
Percent	11.5	11.3	10.3
Amount ($B)	52.699	51.944	47.366

qualify because they are able to pay interest fully, and are short only on principal repayment. After the buydown, an additional 3 percent of total operators (almost 9 percent of operators with a negative NCF initially) show positive cash flows.

Total costs of the program in the first year of the projection are $3.5 billion, basically the difference in total principal and interest shortfalls between this scenario and the "no intervention" BASE scenario. The federal government absorbs about one-third of the costs with the banks writing off the remainder. Lenders benefit from this program since the federal government pays $1.2 billion to lenders for interest and principal repayment. The interest buydown becomes income to the bank that it would otherwise not receive.

Over time, a smaller percentage of operators with negative NCF qualify for the buydown. A larger percentage of operators are able to pay interest, and so are ineligible for the buydown. These percentages are based on a reduced sample population since farms that fail in the first year are assumed to exit farming and are removed from the sample. Average payments per farm increase over time, from $24,294 the first year to $39,480 in the third year, suggesting that more recipients of the buydown require the maximum 6 percent buydown or have larger average debt loads. Total costs of the program in the second and third years of the projection are approximately one-third of the costs of the first year at $1.3 to 1.4 billion. The split in costs remains fairly constant over time at one-third for the federal government and two-thirds for the bank.

The number of operators selling out over the three year period is almost one-fourth less than in the BASE scenario. Fewer operators than in the BASE run sell out in any given year (2.5 percent less in the first year) indicating that the program can successfully buy time for some operators to continue restructuring efforts. Both speed and magnitude of asset sales and debt liquidation are reduced.

Two-way Interest Rate Buydown

Model Specification. Costs of a two-way interest rate buydown with payments limited to interest shortfalls shared by the federal government and lender are estimated (Table 13). The federal government is assumed to buy down interest rates up to 2 points, or to the cash flow point if it occurs with less than the maximum 2 points. An additional 4 percent buydown in interest rates is provided by the banks as needed to eliminate cash shortfalls. Thus, the maximum buydown is 6 points, similar to the FmHA buydown, but the two-way interest rate buydown is limited to interest shortfalls.

Results. Since the maximum rate in the FmHA-type program and two-way buydown is the same, the difference in total program costs ($1.5 billion) indicates the amount of payment exceeding interest shortfalls in the FmHA-type program. The costs to the federal government in the two-way buydown indicate operators

Table 13. Expected Changes Over Time with a Two-way Interest Rate Buydown, United States.

	Year 1	Year 2	Year 3
Assets Sold			
Percent	6.0	1.3	2.2
Amount	27.310	6.114	10.177
Debt Liquidated			
Percent	21.0	4.2	6.9
Amount	26.715	4.17	6.61
Debt Written Off			
Percent	6.4	0.2	0.4
Amount	8.163	0.23	0.40
Operators Selling Out			
Percent	11.4	3.0	2.3
Number	72,429	16,729	12,322
Operators with Negative NCF Before Intervention			
Percent	33.9	22.3	22.7
Number	215,824	125,722	124,162
Operators with Negative NCF Who Qualify for Aid			
Percent	67.6	36.3	35.0
Number	145,860	45,647	43,496
Total Costs ($B)	2.096	0.491	0.548
Federal Costs ($B)	1.003	0.311	0.336
State Costs ($B)	0.000	0.000	0.000
Lender Costs ($B)	1.092	0.181	0.211
Average Payment Per Farm	$14,367	$10,765	$12,595
Interest Shortfall ($B)	0.368	0.010	0.010
Principal Shortfall ($B)	3.620	1.845	1.701
Total Shortfall ($B)	3.988	1.855	1.711
Assets Purchased			
Percent	11.5	11.4	10.4
Amount ($B)	52.699	52.069	47.540

with an interest rate shortfall avail themselves of the maximum government buydown because they require at least a two point break in interest rates to project a positive cash flow. In the first year, the average payment in the two-way buydown is $146,367.

The federal government's portion of the buydown increases after the first year from less than 50 percent to slightly more than 60 percent (Table 13). If the federal government's share is constant at 50 percent, the average percentage buydown required by an individual to cash flow is 4 points (2 points provided by the government and 2 by the lender). Since commercial operators remaining in business who qualify require an average buydown less than 4 points, the government share of costs grows over time.

Targeted Two-way Interest Rate Buydown

Model Specification. To be eligible for the two-way targeted buydown, farm operators must have equity greater than $50,000 but less than $250,000 and be unable to pay interest fully. Thus, the buydown is intended to provide funds to ease financial stress for farms with enough remaining equity to be considered viable. Farms with substantial amounts of equity (greater than $250,000) are assumed to have financial resources to survive without public aid.

Results. The equity bounds determining eligibility reduce the percentage of qualifying operators with negative NCF from 68 percent to 24 percent (Table 14). Since fewer farms are recipients of buydowns, this program does less than other buydown programs to stem the flow of operators who leave because of financial problems. Program costs are also drastically reduced to almost one-fifth of two-way buydown costs. The average payment the first year is $7,821, a little more than half of the average payment in the untargeted two-way buydown and one-fourth of the FmHA buydown. Obviously, many severely stressed farms with large debt loads that would otherwise qualify for larger buydowns have been eliminated from the program by equity constraints.

Two-way Interest Rate Buydown with Payment Limitation

A $10,000 maximum individual payment included in the two-way interest rate buydown reduces program costs (Table 15), but this effect is somewhat deceiving since the $10,000 maximum rarely if ever occurs before the government maximum buydown of 2 points in interest rate, the difference in this program and the basic two-way buydown is mostly in the lender's position. Here, the lender takes income loss as an interest shortfall rather than as a write-down in interest. And, since interest shortfalls are added to debt if the operator remains in business, interest is accrued over time, and some of the income foregone may be recovered later.

Table 14. Expected Changes Over Time with a Targeted Two-way Interest Rate Buydown, United States.

	Year 1	Year 2	Year 3
Assets Sold			
Percent	6.7	3.2	2.6
Amount	30.554	14.620	12.045
Debt Liquidated			
Percent	22.8	9.6	8.2
Amount	28.972	9.39	7.25
Debt Written Off			
Percent	6.0	0.4	0.3
Amount	7.595	0.42	0.25
Operators Selling Out			
Percent	12.2	3.2	2.1
Number	77,353	17,900	11,353
Operators with Negative NCF Before Intervention			
Percent	33.92	21.7	22.0
Number	215,824	122,612	119,977
Operators with Negative NCF Who Qualify for Aid			
Percent	24.1	19.6	37.2
Number	51,964	24,062	44,589
Total Costs ($B)	0.406	0.108	0.098
Federal Costs ($B)	0.229	0.078	0.053
State Costs ($B)	0.000	0.000	0.000
Lender Costs ($B)	0.178	0.029	0.044
Average Payment Per Farm	$7,821	$4,481	$2,187
Interest Shortfall ($B)	2.070	0.343	0.266
Principal Shortfall ($B)	3.620	1.784	1.392
Total Shortfall ($B)	5.690	2.127	1.658
Assets Purchased			
Percent	11.5	11.4	10.6
Amount ($B)	52.699	52.303	48.656

Table 15. Expected Changes Over Time with a Two-way Interest Rate Buydown Subject to Payment Limit, United States.

	Year 1	Year 2	Year 3
Assets Sold			
Percent	6.3	3.5	1.3
Amount	28.762	15.822	5.930
Debt Liquidated			
Percent	21.9	10.3	4.3
Amount	27.800	10.22	3.80
Debt Written Off			
Percent	5.6	0.4	0.2
Amount	7.149	0.41	0.19
Operators Selling Out			
Percent	11.5	3.6	2.1
Number	73.433	20,012	11,246
Operators with Negative NCF Before Intervention			
Percent	33.9	22.2	22.2
Number	215,824	125,353	120,551
Operators with Negative NCF Who Qualify for Aid			
Percent	67.6	36.0	33.0
Number	145,860	45,137	39,789
Total Costs ($B)	1.003	0.308	0.311
Federal Costs ($B)	1.003	0.308	0.311
State Costs ($B)	0.000	0.000	0.000
Lender Costs ($B)	0.000	0.000	0.000
Average Payment Per Farm	$6,876	$6,824	$7,827
Interest Shortfall ($B)	1.461	0.268	0.178
Principal Shortfall ($B)	3.620	1.825	1.575
Total Shortfall ($B)	5.080	2.093	1.753
Assets Purchased			
Percent	11.5	11.4	10.4
Amount ($B)	52.699	52.166	47.538

Comparison of Interest Rate Buydowns Over Three Years

Impacts on Farms. Interest rate buydown programs prevent accumulation of interest over time on financially stressed farms. As a result, fewer assets are sold, fewer debts are liquidated, and fewer farms fail. Of the interest buydown programs simulated, the FmHA-type program reduces the number of commercial operators selling out most over the three year period. It also does most to reduce the volume of assets sold as farms adjust to financial stress.

The difference between BASE total shortfalls ($9.9 billion) and total shortfalls plus program costs with the FmHA-type program ($10.7 billion) is $758 million. Other buydown programs also have total shortfalls and program costs that exceed total shortfalls in the BASE program over three years. This indicates the increase in losses resulting from keeping some severely stressed farms in operation. Additional accrued losses in other programs range from $758 million with the FmHA buydown to $146 million with the targeted two-way buydown.

Impacts on Banks. Interest buydown programs impact banks two primary ways. First, if government agencies participate, funds received by the lender reduce the lender's immediate loss of income. Second, if the bank participates in the buydown, the borrower's interest shortfalls are reallocated between interest shortfalls and interest written off. Because of this second impact, total long run costs of the program are difficult to estimate. An interest shortfall may provide income to the lender in the future if the farm remains solvent. Interest written off, on the other hand, results in a permanent loss of income. With the FmHA-type buydown, banks absorb losses of $4.4 billion in interest and principal shortfalls and $4.2 billion in interest written off (the bank's interest buydown costs) over three years (Table 10). The total shortfall is $8.6 billion with the FmHA-type buydown, compared to $9.9 billion in the BASE run.

Land Holding Company

The land holding companies proposed by Harl (1986), the Farm Credit Council (1985) and others could insulate land and machinery markets from a glut of sales by debtors at or approaching insolvency. The proposed land holding company acquires land from farmers subject to foreclosure or bankruptcy, lenders holding land in inventory, or farmers unable to service their real estate debt. Farmers who want to dispose of property thus have a ready buyer even in areas where asset sales have flooded the market. The holding company serves as a shock absorber protecting collateral values and reducing the probability of serious "overshooting" in land prices (Harl, 1986). Overshooting becomes a problem when financially stressed farmers attempt to restructure by selling assets. Lower asset values mean more assets have to be sold to generate revenue to cover cash shortfalls.

Harl's (1985B) proposed federally chartered Agricultural Financing Corporation (AFC) has two major components. The first provides supplemental financing for "buying down" interest rates on farm loans for farms with the potential for positive cash flows. The second provides a mechanism for buying assets of farmers unable to project a positive cash flow without asset liquidation. The proposed AFC would acquire farmland at fair market value and rent the assets to farmers (with first preference to prior owners of the asset) at a fair rental rate. Lenders holding loans transferred to the AFC with associated collateral would be expected to take a write-down on the loan obligation or interest rate charged and could not charge an interest rate higher than the best rate charged their best farm customers. Prior owners of the assets who maintain continuous or near continuous rental of the asset would be eligible to repurchase the assets at fair market value.

Model Specification

In the simulation of the land holding company (LHC), the rudiments of the AFC and ACC are incorporated. The LHC is assumed to be a limited life corporation entitled to purchase assets from financially stressed farm operators. Borrowers with a negative NCF who are unable to make interest payments are allowed to sell assets to the LHC and lease them back at reasonable cash rental rates. In simulations over time, "reasonable" means current rental rates if rates of return exceed rental rates or one percentage point less than the rate of return if rental rates exceed rates of return in the first year. With subsidized rental rates, farmers may sell fewer assets to the LHC than would have to be sold to project a positive cash flow with a sale/leaseback.

Proceeds from a farm's sale of assets to the LHC are applied to debt reduction. Asset sales to the corporation are limited to half of assets owned or $300,000, unless the operator is insolvent. Insolvent operators transfer all assets to the holding company. Sellers to the LHC are required to purchase stock in the LHC equivalent to 10 percent of the assets transferred to it.

Costs to the federal government of providing a LHC depend on the cost of funds used by the LHC to purchase assets and income earned by renting out assets purchased. Costs of funds are assumed to be 7.75 percent in each year, a rate equivalent to the sale price of Farm Credit System bonds in February 1986 (Webster, 1986). Total costs of the LHC include purchase of assets entering it plus the costs of financing those purchases less rental income earned and less proceeds from sale of assets on or before the end of the entity's limited life.

Results

Almost 10 percent of the assets of commercial farm operators are sold, 2.5 percent more than in the BASE run (Table 16). More debt is liquidated in the first year than in the BASE run (29 percent as opposed to 24 percent) because of

Table 16. Expected Changes Over Time with a Land Holding Company, United States.

	Year 1	Year 2	Year 3
Assets Sold			
Percent	9.7	1.5	1.6
Amount	44.380	7.007	7.191
Debt Liquidated			
Percent	28.9	5.7	6.2
Amount	36.640	5.16	5.27
Debt Written Off			
Percent	6.6	0.3	0.2
Amount	8.357	0.29	0.18
Operators Selling Out			
Percent	9.5	1.9	1.4
Number	60,718	10,491	7,473
Operators with Negative NCF Before Intervention			
Percent	33.9	20.5	22.4
Number	215,824	115,343	123,771
Operators with Negative NCF Who Qualify for Aid			
Percent	67.6	41.5	35.5
Number	145,860	47,829	43,992
Total Costs ($B)	0.864	0.087	0.145
Federal Costs ($B)	0.864	0.087	0.145
State Costs ($B)	0.000	0.000	0.000
Lender Costs ($B)	0.000	0.000	0.000
Average Payment Per Farm	$5,924	$1,817	$3,290
Interest Shortfall ($B)	1.537	0.515	0.009
Principal Shortfall ($B)	2.273	1.292	1.508
Total Shortfall ($B)	3.810	1.807	1.517
Assets Purchased			
Percent	11.5	12.0	10.4
Amount ($B)	52.699	54.777	47.540

debt retirement from the proceeds of asset sales to the LHC. More debt is written off when a stock purchase is required since failing farms have to apply some of the proceeds from sale of assets to stock purchases rather than debt retirement.

Fewer operators fail with an operating LHC because of financial problems over time--9.5 percent of commercial farms fail the first year and 12.4 percent of total sample operators liquidate completely in the three year period. Although many farms sell assets to the LHC, the average payment per farm is small since it is the costs of financing the program above rentals received on the assets sold to the corporation. Over three years, assets sold and debt liquidated are approximately the same in the BASE and LHC simulations. With the LHC, though, an estimated 33,349 operators remain in business who fail in the BASE scenario. Fewer operators sell out in the LHC simulation than in any interest buydown programs simulated.

Annual program maintenance costs are less than the cost of most buydown programs examined. The combined LHC maintenance costs and interest and principal payment shortfalls are substantially less than in other scenarios. The sum of interest and principal shortfalls and LHC maintenance costs is actually less ($1.7 billion) than the total shortfalls in the BASE scenario. However, when total cost of asset purchases are considered, the costs of the LHC are high. A rough calculation of the present value of the LHC is made assuming:

1. Assets are purchased only in the first year.

2. The total amount of assets purchased is $77 billion (17 percent of the total assets of commercial operators).

3. The life of the LHC is five years.

4. Assets are sold at the end of the fifth year.

5. The cash rental rate is 6 percent of the initial market value.

Total costs, given different assumptions about discount rates and rates of asset appreciation, are listed in Table 17. It could be argued that the discount rate should reflect some "social" rate that might be near 2 percent rather than the market interest rate that could equal or exceed 10 percent.

Summary and Conclusions

We have estimated the magnitude of change faced by the agricultural sector because of current farm financial conditions. Our simulation of farms' adjustment in response to financial stress relates farm-level changes to a sector response. Estimates of national restructuring requirements are large, even with

Table 17. Costs of Land Holding Company ($B), United States.

Discount Rate	Annual Land Value Appreciation Rate		
	0%	1%	2%
2%	13.6	10.1	6.6
5%	16.4	19.4	16.4
10%	34.3	31.9	29.5

optimistic assumptions about farm incomes, interest rates, asset market resiliency, and off-farm income availability. Financial conditions are particularly severe in the Central region and consequently that restructuring is expected to be extensive.

Our examination of the financial status of United States commercial farms suggests that stress on asset markets, agricultural lenders, and farm operators is not expected to abate soon. Many farms have debt levels that are unsupportable at projected income levels and interest rates. Continued shifts in asset and debt holdings are expected as the sector moves toward a financial equilibrium. Farms near failure financially are not substantially helped by moderate restructuring. Many severely stressed farms--those with high debt-to-asset ratios, large negative net cash flows, and low farm equities--may not be able to restructure debts and assets and will fail soon. In the Central region of the United States, a large number of farms are expected to liquidate completely.

Our analysis suggests justification for considering public intervention to alleviate farm financial stress. The expected financial transition will likely test the ability of markets, individuals, institutions, and communities to make these changes. Financial policy can facilitate the transition process by buying time for operators and lenders to make needed long term adjustments and by ensuring that markets continue to operate efficiently. Interest rate buydowns and land holding company are programs that aid the farm in meeting current expenses and help reduce interest accumulation while the operator attempts debt or asset restructuring. Both the speed and magnitude of operator, asset, and debt liquidation can be reduced with these programs. The land holding company also benefits financially healthy farm operators by helping to stabilize farm asset markets and values.

Benefits of different programs are hard to value because of their indirect and uncertain impact over time. The lender's participation in a program may lead to a certain loss of future income if interest or debt is written off. Reduction of

either the interest or principal payment obligation has tax consequences that may be important to both the borrower and lender.

An important attribute of public intervention to alleviate financial stress is the sharing among several entities of costs imposed by financial stress. Since causes of financial stress include macroeconomic policies and lenders' and farmers' financial practices, it is reasonable to expect the costs of financial stress to be shared by government, lenders, and farmers. Different programs distribute the cost burden and risks associated with farm failure differently among the entities involved. Simulation results indicate that intervention to alleviate farm financial stress may be expensive. Costs of programs depend on the extent of aid provided per individual and the number of operators qualifying for aid. Continuation of the current policy of "doing nothing" could result in costs--both in economic and human terms--that easily exceed the cost of intervention.

The long term viability of financially stressed farms depends on their ability to improve cash flow and restructure debts and assets. Higher incomes, either farm or off-farm, enhance debt servicing capability and reduce restructuring needs. Since farm incomes are not expected to improve soon, creation of jobs in rural areas or off-farm job training for financially stressed farmers or their families could be valuable. Extension or vocational school programs to improve management skills of farm operators could also prove beneficial in the long run. Helping farmers to explore on and off-farm opportunities is an urgent need.

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